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III. BIOLOGY.

SOME DIATOMACEÆ OF KANSAS.

BY GEO. H CURTIS, MCPHERSON.

DIATOMACEÆ OF GAGE'S POND, TOPEKA, AND OF SILVER LAKE.

Read before the Academy, at McPherson, December 29, 1899.

Although the Diatomaceæ of the eastern United States have been pretty thoroughly investigated by several competent observers, I believe that little is known as to what forms exist in the West. With the exception of Thomas and Chase's catalogue of the Diatomaceæ of Lake Michigan, which embraces 34 genera and 214 species, and my own catalogue of the Cincinnati forms, 42 genera and 972 species, there are no investigations of western or central-western forms known to me.

Under these circumstances, perhaps a short paper upon Kansas forms may possess sufficient interest to justify reading it.

In company with Mr. Frank Patrick, I paid a visit to Gage's pond, in the western suburbs of Topeka, about the middle of October. It was dug by Mr. Gage a number of years ago as a fish-pond and stoned up. I did not think of estimating its dimensions while there, but is perhaps 150 feet long by 50 feet wide, and two or three feet deep. Our object in visiting it is was to ascertain if it contained diatomaceous material; and, while there, I made a gathering which, when cleaned up a few days afterward, yielded some very interesting slides, and some *Naviculae* not previously met with elsewhere.

The most abundant form in the gathering was *Epithemia gibba*, both the long and the short varieties. The most common *Navicula* was *radiosa*. *Cymbella stomatophora* of several sizes was also common; and *Amphipleura pellucida*, a rare form, more than usually abundant. My gathering was made on the east side, about midway; and it was rather curious that there was no *Amphipleura* in Mr. Patrick's gathering, made only a short distance away at the south end, or from the under sides of the leaves of the water-lilies, of which many were growing in the pond. *Synedra ulna*, var. *longissima*, was abundant, especially in Mr. Patrick's gathering. *Gomphonema* was rather rare. There were a considerable number of large, somewhat curved, sponge spicules. *Navicula cuspidata* was a prominent form—both the long and the short varieties. *Cymbella*, usually one of the most abundant forms in any gathering East, was very scarce at Gage's pond, as well as *Gomphonema*.

The most noticeable thing about the gathering was the remarkable predominance of the rare form, *Epithemia gibba*, of which there were, in a field taken at random, under a quarter-inch objective, no less than seventy-eight individuals, as compared to nine *Cymbellæ*, four *Naviculae*, thirteen *Synedræ*, and four *Denticulæ*—almost three times as many as all the other forms together.

As some may not have had experience with the microscope, I would say that the field of view mentioned above was round, and one-fiftieth of an inch in diameter. This will convey some idea of the exceedingly minute size of these diatoms: that 108 of them, as mentioned above, could, without any crowding whatever, be placed in a circle of that size.

To give an idea of the rarity of *Epithemia gibba* at other places, I may say that, in the forty-four slides from which my catalogue of the Cincinnati Diatomaceæ was drawn up, representing about thirty different gatherings, this diatom is found in only two of them. In a very remarkable gathering I made from the Fox river, at Elgin, Ill., a half-inch mount of which contained ninety-four recognized species, only two *Epithemia gibba* were observed, and in one from a pond in Oakwood park, Elgin, none; nor were there any in fine gatherings made at places so widely scattered and generally representative of the West and South as Lake Geneva, Wis., Hailey's Springs, Idaho, or Calera, Ala. There were none in a gathering I made from the Chicago water-supply, though it is catalogued in Thomas and Chase's Diatomaceæ of Lake Michigan, from which the city water-supply is derived. Two fine gatherings made in northeastern Ohio, near Ashtabula, contained no *Epithemia gibba*. A gathering made early in October from the fountain basin on Twelfth street, two or three blocks southwest of the capitol, in Topeka, contained hardly anything else but this *Epithemia*; so that its abundance here seems to be a remarkable peculiarity of this locality, depending, perhaps, on some constituent of the water-supply unusually favorable to it. If so, it must, I imagine, be derived from the Republican branch of the river, as a gathering I made from the Blue at Beatrice, Neb., last year, contained none of this diatom.

In connection with *Amphipleura pellucida*, mentioned above, it is not only very rare, but is placed at the end of Möller's test plate as the most difficult test object known to microscopists, and is stated in scientific text-books to be the smallest regularly organized thing known. The figure I give (fig. 30, pl. III) is not very satisfactory, but may serve to convey an idea of it. Of course, the delicate markings referred to below are not visible at 775 diameters, and the lines across the middle are merely a very coarse imitation of them, to show their direction, etc.

Mr. Patrick informed me that he very carefully examined the alga the *Amphipleura* was growing on and found it to be *Cladophora fracta* Kg., which I believe only grew over a small space on the east and north walls, a fact very interesting, as showing that it is probably parasitic on this alga, and only found in connection with it, something not before observed, so far as known to me. This would account for its not being found under the lily-pads, or at the south end, where this alga did not grow. The rarity of this diatom may be due to the fact that this alga does not grow everywhere.

As possessing possible interest, I may say that I once measured *Amphipleura pellucida* by a Rogers stage micrometer, and found it not quite one two-hundredths of an inch in length. The smallest grains of ordinary sand which can be picked up with a pair of watchmaker's tweezers and arranged as close together as possible under a magnifying glass go only sixty-four to an inch, so that the length of this diatom is only a little over one-quarter of the diameter of one of the finest grains of sand; yet in this short length it is marked with 340 of the finest and most regular lines ever seen ruled across it, and each line apparently composed of rows of beads. I counted these lines on an excellent photograph of it, by Doctor Detmers. A list of the genera and species found at Gage's pond is as follows:

<i>Achnanthes minutissima.</i>	<i>Cocconema cistula.</i>
<i>Amphipleura pellucida.</i>	<i>Cocconema lanceolatum.</i>
<i>Amphora libyca.</i>	<i>Cocconema mexicanum.</i>
<i>Amphora ovalis.</i>	<i>Cocconema</i> (a large unknown, perhaps new).
<i>Cocconema australicum.</i>	

<i>Cymatopleura elliptica.</i>	<i>Navicula gibba</i> (Pinn.)
<i>Cymatopleura solea</i> (both long and short).	<i>Navicula hemiptera.</i>
<i>Cymbella gastroides.</i>	<i>Navicula interrupta.</i>
<i>Cymbella stomatophora.</i>	<i>Navicula lanceolata.</i>
<i>Cymbella turgidula.</i>	<i>Navicula lanceolata</i> , var. much smaller.
<i>Denticula elegans.</i>	<i>Navicula mesolepta.</i>
<i>Denticula tenuis.</i>	<i>Navicula nodosa</i> , var.
<i>Denticula thermalis.</i>	<i>Navicula</i> (No. 15, Schmidt's Atlas, pl. 44).
<i>Diatoma tenue.</i>	<i>Navicula</i> (No. 44, Schmidt's Atlas, pl. 45).
<i>Encyonema lunula.</i>	<i>Navicula</i> (No. 45, Schmidt's Atlas, pl. 44).
<i>Encyonema turgidum.</i>	<i>Navicula</i> (No. 55, Schmidt's Atlas, pl. 7, with some reserve).
<i>Epithemia gibba.</i>	<i>Navicula oculata.</i>
<i>Epithemia gibba</i> , var. <i>ventricosum</i> .	<i>Navicula oblonga.</i>
<i>Epithemia sorex</i> , short form.	<i>Navicula peregrina.</i>
<i>Eunotia gracilis.</i>	<i>Navicula producta.</i>
<i>Eunotia lunaris.</i>	<i>Navicula pseudobacillum.</i>
<i>Eunotia lunula.</i>	<i>Navicula radians.</i>
<i>Fragellaria intermedia.</i>	<i>Navicula radiosa.</i>
<i>Fragellaria mutabilis.</i>	<i>Navicula radiosa</i> , var. <i>acuta</i> .
<i>Gomphonema abbreviatum.</i>	<i>Navicula retusa.</i>
<i>Gomphonema affine.</i>	<i>Navicula rhyncocephala.</i>
<i>Gomphonema affinis.</i>	<i>Navicula rostellata.</i>
<i>Gomphonema angustatum.</i>	<i>Navicula</i> (small, elliptical, coarsely marked, fig. 10, pl. II).
<i>Gomphonema angustatum</i> , var. <i>intermedia</i> .	<i>Navicula schumanniana.</i>
<i>Gomphonema angustatum</i> , var. <i>producta</i> , Grün.	<i>Navicula stauroneiformis.</i>
<i>Gomphonema commutatum.</i>	<i>Navicula stauroptera.</i>
<i>Gomphonema constrictum.</i>	<i>Navicula stomatophora</i> Grün.
<i>Gomphonema gracile</i> , forma <i>parva</i> .	<i>Navicula subinflata</i> (fig. 23, pl. III).
<i>Gomphonema lagenula</i> Kg.	<i>Navicula tabellaria</i> Grün.
<i>Gomphonema mexicanum</i> Grün.	<i>Navicula trinodis.</i>
<i>Gomphonema obtusatum.</i>	<i>Navicula ventricosa</i> , forma <i>minuta</i> .
<i>Gomphonema olivaceum.</i>	<i>Navicula viridis</i> (Pinn.)
<i>Gomphonema parvulum.</i>	<i>Navicula viridula</i> Kg., forma <i>minor</i> .
<i>Gomphonema parvulum</i> , var. <i>subcapitata</i> .	<i>Nitzschia frustulum.</i>
<i>Melosira lyrata</i> , var. (?).	<i>Nitzschia sigma.</i>
<i>Meridion circulare.</i>	<i>Nitzschia</i> (small, unknown, coarse markings).
<i>Navicula acrospheria</i> , var. (?).	<i>Pleurosigma spencerii.</i>
<i>Navicula arenaria</i> Donk.	<i>Stauroneis anceps.</i>
<i>Navicula bacilliformis.</i>	<i>Stauroneis phenicenteron.</i>
<i>Navicula biceps</i> Ehr.	<i>Stauroneis</i> (unknown, small).
<i>Navicula brebissoni.</i>	<i>Surirella apiculata.</i>
<i>Navicula cuspidata.</i>	<i>Surirella molleriana.</i>
<i>Navicula decurrens</i> (Pinn.)	<i>Surirella ovata.</i>
<i>Navicula divergens</i> , forma <i>minor</i> .	<i>Surirella ovata</i> , var.
<i>Navicula elliptica</i> , var. <i>oblongella</i> (fig. 24, pl. III).	<i>Surirella panduriformis.</i>
<i>Navicula flanatica.</i>	

Suriella suevica.	Synedra superba.
Synedra crotonensis.	Synedra ulna, var. longissima.
Synedra danica.	Synedra ulna, var. vitrea.
Synedra familiaris.	
Synedra pulchella.	Total genera, 21; species, 108.

Many more might undoubtedly be discovered by devoting time to the more thorough examination of the slides, as I never sit down to them without finding something new. As sixty species is a fair average for the best gatherings, it will be seen that this at Gage's pond was unusually good.

A gathering made at Silver Lake, twelve miles west of Topeka, yielded much the same forms, except that in a half-inch mount of it only two *Epithemia gibba* were observed, and with the following additions:

Achnanthes hudsonis.	Navicula confervacea, var. peregrina, Grün. (fig. 17, pl. III).
Achnanthes exilis.	Navicula lanceolatum.
Achnanthes lanceolatum.	Navicula sphærophorum.
Cocconema cistula (a new variety).	Nitzschia dissipata.
Cyclotella comta.	Nitzschia hungarica.
Cyclotella meneghiniana.	Nitzschia paradoxa.
Cymatopleura apiculata.	Nitzschia sigmaidea.
Encyonema triangulum.	Nitzschia tryblionella, forma minor.
Fragellaria turgens.	Nitzschia tryblionella, forma densus striatae.
Gomphonema affine, forma major.	Nitzschia tryblionella, var. victoriae.
Gomphonema gracile.	Pleurosigma eximum.
Melosira crenulata.	Pleurosigma hippocampus (?).
Melosira varians.	Pleurosigma delicatulum.
Navicula ambigua.	Suriella intermedia.
Navicula ampliata.	

One additional genus, *Cyclotella*, and twenty-nine species.

DIATOMACEÆ OF RENO COUNTY, KANSAS.

(Read before the Academy, at Topeka, December 28, 1900.)

Mr. S. G. Mead made a gathering last fall at Medora, Reno county, which he said he did not clean up well and he wished me to try it. On account of much flocculent matter, which seems to be a silicate which the diatoms grow in, also much fine sand of the same specific gravity as the diatoms, as well as the vast difference in the size and weight of the latter, some being among the largest and some among the smallest forms known, it was the most difficult material to deal with, by either subsidence or flowing, that I have ever met with; and the difficulties were much increased by there being so little of it to work upon—only a thin skin of black mud, about half a thimbleful, at the bottom of a tumbler.

I however succeeded in getting four or five fair slides, which conclusively proved it to be a very rich material, and that the forms of the western part of the state, as compared with the eastern, such as those of Gage's pond and Silver Lake, were unexpectedly large and interesting.

It had for some time been an opinion of mine, formed from a number of gatherings made around Salina and McPherson, that the central and western parts of the state were decidedly poor, if not altogether deficient in large forms of any kind. Still, about the first thing seen after placing the Medora slides under the microscope was one of the very largest *Nitzschiae*, long, and a little curved, perhaps *spectabilis*, or new (?), (see fig. 14, pl. II) and large enough to be easily re-

solvable by a 1-4, central light—something very exceptional in that genus, which are usually so finely marked as to be among our most difficult test objects, and usually unresolvable by almost any power and central light.

There was a great abundance of fine *Surirellæ*, mostly *tenera*, *splendida*, or varieties, which are among the largest diatoms in that genus. Also, another much longer but narrow, like fig. 8 of Schmidt's Atlas, pl. XXIII, one of the largest *Surirellæ*, and a very unusual form, not found at Cincinnati, Gage's pond, or Silver Lake. (See fig. 13, pl. II.)

The smaller forms, too, were very numerous and interesting, and included many, especially several small, oval *Naviculæ*, which could not be recognized from any of the authorities at hand, and were perhaps new. As is usual, *Navicula* was the most abundant form as to species, though by no means as to individuals.

One of the features of these Medora slides was the almost entire absence of *Gomphonema*, as noticed also in eastern Kansas—one of the most abundant forms everywhere else, and so abundant at Cincinnati that many slides of the forty-four mounted there contain hardly anything else; but they were so scarce at Medora that I was inclined for some time to think them altogether absent; though I eventually succeeded in finding several in the five slides, almost all of different species.

Melosira, a very abundant genus at Cincinnati, was altogether absent at Medora. *Cocconeis*, a very common form, especially *pediculus*, was not observed in the Medora slides nor at Gage's pond nor Silver Lake, though there was one in the stomach of the little fish caught at Belvidere. Only one individual of *Meridion* was met with, and only one *Synedra*, which at Cincinnati was the second most abundant form, *Nitzschia* being first.

There are usually *Pleurosigmæ* in almost every gathering made anywhere; and there were plenty at Belvidere, not far away; but, very curiously, not a single one could be found in these Medora slides.

Cymbella is usually a very abundant form everywhere, almost as much so as *Gomphonema*, it being present at Cincinnati in the proportion of eighty to eighty-eight of the latter; but it was so rare at Medora as to be seldom seen. *Eunotiae*, common at Cincinnati, were entirely absent in Kansas, none having been found at Gage's pond, Silver Lake, or Medora.

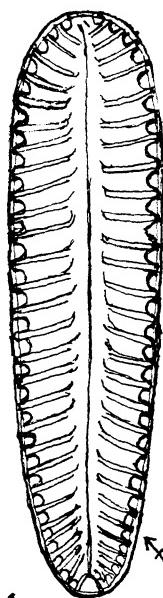
I know not how to account for the almost entire absence of these forms so universally abundant in the Eastern states and the central West, unless we suppose it to be due to the only abnormal condition present, so far as known to me; that is, to salt or alkali, especially the latter, which whitens the surface around the marshes in that section whenever the water goes down.

There are several curious unrecognizable pieces found in the five slides. One of them resembled part of a shell, apparently. The central half rose up in a boss or swelling, surrounded by a flat surface covered with irregular wavy lines.

There were a good many cylindrical pieces, appearing under a 1-10 to be about an inch or an inch and a quarter long, and an eighth of an inch or a little more in diameter; very rough outside. No fresh-water sponge spicules were seen, which I should otherwise have been inclined to connect them with, and it was impossible to tell just what they were.

A second piece (fig. 11, plate II), a round, saucer-shaped disk, I at first thought a *Coscinodiscus*, common in salt water, but of which there is only one represented in fresh water, *C. lacustris*, of which one individual was found in the forty-four Cincinnati slides; but which is very rare. The central part was reticulated in hexagons like honeycomb. It was so dishing I could not get enough

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Medora. 5. $\times 425$. Fish 1.

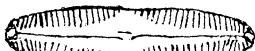
1.

Medora 4. $\times 775$.

8.



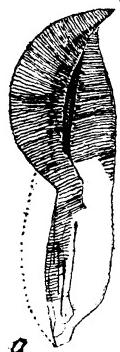
2.

Medora 4. 1720. $\times 775$ 

3.

Medora. $\times 775$.

5.

Fish 1. $\times 425$. Same $\times 425$. *Medora* 4. $\times 775$.

9.



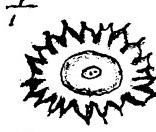
10.

 $\times 775$.Fish 2. *Medora* $\times 425$. $\times 775$.

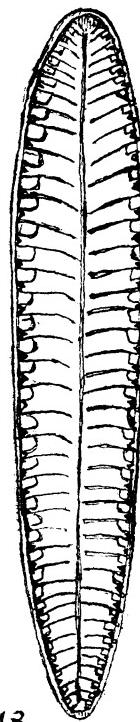
4.

Fish 2. $\times 775$.

7.

11. $\times 775$ *Medora*.

12.



13.

14.

of it in focus at a time to make a very satisfactory drawing of it; but I have done the best I could.

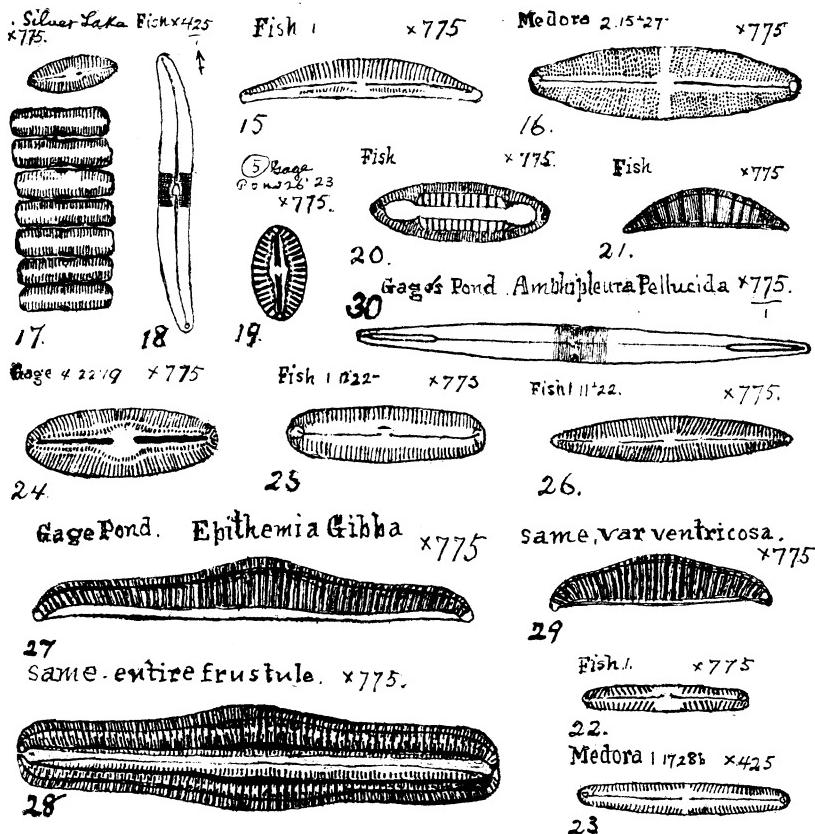
The upper edge seems to be hidden under some kind of trash, which, if it were away, might reveal the border, which would establish whether it was *C. lacustris* or not; still, I have little doubt that it is, or of that family. When best adjusted, the hexagons appeared somewhat dark, with a round, white dot in the center of each, as on the right of the figure; but, by adjusting up a very little, the white circles disappeared, and were replaced by small, black dots, like those of *Triceratium favus*, as seen on the left.

One of the most curious things found had no particular color beyond a slight smoky tint, and the central part was raised up into a sort of boss or umbo, in the center of which there was a rather dark-blue spot, in which were usually two grains of something like black sand, though sometimes only one. Some are much more regular in outline, as well as larger than the one I made the drawing from (fig. 12, pl. II); and they are moderately plentiful, say two to five in a half-

PLATE II.

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PLATE III.



inch mount. The points are each protected by a long, sharp thorn of a darker color, inclined to black.

Mr. Frank Patrick, of Topeka, suggested its being part of a fresh-water sponge spicule, which seems very probable, as it would explain its having survived the action of boiling nitric acid, otherwise difficult to account for. In this view of the case, we may suppose that it formed the ends or caps to the cylindrical pieces mentioned above, and part of the birotulate spicule of some species of *Myenia*.

I was unable to get enough of it in focus at one time to make a satisfactory drawing of the right-hand side of the large *Surirella* (fig. 1, pl. II), as every slight change of adjustment caused a different appearance of it. The alea, however, seemed to be like those of *S. tenera*, and the contour is right. It is nearly of the same size at each end, and I was unable to find anything like the unusual wide lower third of it in any of my books of reference, and it is, possibly, a deformity. It was finally decided to be a *S. robusta* of Ehrenberg. The *Surirellæ* and the *Nitzschicæ* (fig. 14, pl. II), were drawn at 425 to 1, as I did not have room for them larger.

Not to make this too long and tedious, I will say that the collection of diatoms

found at Medora is as follows, so far as recognized; there is some doubt in the case of a few of them, indicated by an interrogation point (?):

- | | |
|---|--|
| <i>Achnanthes biasolettiana</i> Grün. | <i>Navicula borealis</i> , var. (larger and more coarsely marked). |
| <i>Achnanthes exigua</i> . | <i>Navicula brebissoni</i> . |
| <i>Achnanthes hudsonis</i> . | <i>Navicula columnaris</i> . |
| <i>Achnanthes lanceolata</i> . | <i>Navicula commutata</i> . |
| <i>Achnanthes minutissima</i> Kg., forma curta. | <i>Navicula confervacea</i> Kg., var. hungarica (fig. 5, pl. II). |
| <i>Achnanthes trinodis</i> . | <i>Navicula conspicua</i> . |
| <i>Cocconema cymbiforme</i> . | <i>Navicula cryptocephala</i> . |
| <i>Cymbella amphicephala</i> . | <i>Navicula cuspidata</i> . |
| <i>Cymbella anglica</i> . | <i>Navicula dicephala</i> W. S. |
| <i>Cymbella naviculiformis</i> . | <i>Navicula dicephala</i> W. S., forma minor, Grün. |
| <i>Cymbella</i> (No. 52 of Schmidt's No. 9, not named). | <i>Navicula dilatata</i> . |
| <i>Cymbella pusilla</i> of Grünow. | <i>Navicula dirhynchus</i> . |
| <i>Denticula tenuis</i> . | <i>Navicula dubia</i> Greg. |
| <i>Encyonema</i> (large, like Schmidt's Atlas, pl. 71, fig. 18). | <i>Navicula elliptica</i> . |
| <i>Encyonema lunula</i> . | <i>Navicula elliptica</i> , var. minuta Grün. (fig. 4, pl. II). |
| <i>Encyonema</i> (No. 61 of Schmidt's Atlas, pl. 10). | <i>Navicula firma</i> Kg. |
| <i>Encyonema ventricosum</i> . | <i>Navicula firma</i> , var. subampliata. |
| <i>Epithemia gibba</i> . | <i>Navicula fontinalis</i> Grün. |
| <i>Epithemia gibba</i> , var. ventricosum. | <i>Navicula gibba</i> (Pinn.) |
| <i>Epithemia gibberula</i> . | <i>Navicula inflata</i> . |
| <i>Fragellaria elliptica</i> , forma minor. | <i>Navicula interrupta</i> (Pinn.) |
| <i>Fragellaria intermedia</i> . | <i>Navicula lanceolata</i> Kg. |
| <i>Fragellaria mutabilis</i> . | <i>Navicula leptogongyla</i> Kg. |
| <i>Gomphonema affine</i> . | <i>Navicula linearis</i> . |
| <i>Gomphonema angustatum</i> . | <i>Navicula macra</i> , var. ? (fig. 8, pl. II). |
| <i>Gomphonema auritum</i> A. Braun. | <i>Navicula major</i> (Pinn.), ex re Grün. |
| <i>Gomphonema clavatum</i> . | <i>Navicula mesostyla</i> (Pinn.) Ehr. |
| <i>Gomphonema insigne</i> . | <i>Navicula nobilis</i> Ehr., var. (No. 3 of Schmidt's Atlas, pl. 43). |
| <i>Gomphonema lagenula</i> . | <i>Navicula</i> (No. 22 of Sch., pl. 49, not named). |
| <i>Gomphonema monatum</i> , var. subclavatum. | <i>Navicula</i> (No. 40 of Sch., pl. 49, not named). |
| <i>Gomphonema sarcophagum</i> . | <i>Navicula</i> (No. 44 of Sch., pl. 44, not named). |
| <i>Meridion circulare</i> . | <i>Navicula</i> (No. 47 of Sch., pl. 50, not named). |
| <i>Navicula acrospheria</i> . | <i>Navicula</i> (No. 75 of Sch., pl. 45, not named). |
| <i>Navicula affinis</i> . | <i>Navicula obtusata</i> W. S. |
| <i>Navicula alternans</i> . | <i>Navicula producta</i> W. S. |
| <i>Navicula amphirhynchus</i> Ehr. | <i>Navicula pseudobacillum</i> . |
| <i>Navicula ampliata</i> . | <i>Navicula pupula</i> (?). |
| <i>Navicula arenaria</i> Donk. | <i>Navicula rhynchocephala</i> . |
| <i>Navicula bacillum</i> . | <i>Navicula rupestris</i> (Pinn.) Hautsch. |
| <i>Navicula bacillum</i> , forma minor. | <i>Navicula stauroparva</i> . |
| <i>Navicula bicapitata</i> Lag., var. hybrida (fig. 3, pl. II). | |
| <i>Navicula borealis</i> , (type form). | |
| <i>Navicula borealis</i> , var. (No. 16 of Schmidt's Atlas, fig. 45.) | |

Navicula stauroptera.	Stauroneis phoenicenteron.
Navicula subinflata.	Surirella apiculata.
Navicula tenella Breb.	Surirella delicatissima of Lewis.
Navicula tuscula.	Surirella (like 64 of Sch., fig. 23).
Navicula undulata.	Surirella (like saxonica, but very coarsely marked).
Navicula, unknown (figs. 16 and 23, pl. III).	Surirella molleriana, var.
Navicula veneta.	Surirella nobilis Grün.
Navicula viridis A. S.	Surirella robusta Ehr. (fig. 1, pl. II).
Nitzschia amphioxys.	Surirella splendida.
Nitzschia apiculata.	Surirella tenera Greg.
Nitzschia communis.	Surirella tenera, var. splendidula.
Nitzschia lanceolata.	Surirella tenera, var. nervosa, A. S.
Nitzschia palea.	Synedra lanceolata.
Nitzschia paradoxa Grün.	Total genera, 14; species, 111.
Nitzschia spectabilis.	

THE FOOD OF FISH IN CENTRAL KANSAS.

Read before the Academy, at Topeka, December 29, 1900.

Mr. S. G. Mead, of McPherson, gave me a small fish about two inches long, which he caught at Belvidere, Kiowa county, Kansas, last fall. It was apparently a young perch, to judge from its shape and the dark bands along its sides. Having a curiosity to know what its food had consisted of, I undertook a microscopical examination of the contents of the digestive tract; but the difficulty of arriving at satisfactory results was much increased by the carbolic acid and oil the fish had been preserved in, which interfered very much with the proper action of chemicals, especially acids, and did not seem to yield well to either soap, benzine, or alcohol.

The investigation was, therefore, not altogether so satisfactory as I could wish; but was sufficiently so to establish the main points, and to prove that their food consists very largely of diatoms, mostly *Naviculae*, of the *radiosa* type; of which I was able to make a very satisfactory examination, to be referred to again further on. There were also many starch grains, shown by the polariscope to be those of the potato, and about as many, perhaps, which were smaller, and possibly derived from bits of bread. There were also a number of green bodies of roundish contour, which were without much doubt desmids. They had been too long subjected to the action of the gastric secretions for the species to be exactly made out, but they were probably *Cosmariums* of some sort; and their numbers were apparently too small for them to have formed a very important part of the fish's diet. About a dozen grains of corn-smut were met with, all in one place.

There was a very considerable quantity of white sand in the stomach and intestines, hardly any field of view in the microscope one-fiftieth of an inch in diameter being without a number of grains of it. They were generally of about the same size as ordinary river sand, and polarized equally well. In one field of the size mentioned above there were thirteen grains of it, in another nine, and in a third five, of three taken at random. It may be possible, though hardly probable, that this sand was swallowed accidentally. It is, however, far more likely that it was swallowed designedly, to aid the process of digestion, as is the case with birds; and the size of these sand grains would, considering the difference in size of the two creatures, apparently bear a just proportion to the little stones swallowed for this purpose by fowls.

They may also have been swallowed to act by their weight as ballast to counteract the natural buoyancy of the body, like the stones of considerable size usually found in the stomachs of alligators, and which are supposed to have been swallowed to assist them in remaining at the bottom.

The fact that there were no grains of black sand among it, which does not polarize, would rather seem to lend support to the digestive theory; inasmuch as white sand, being composed of quartz, or almost pure silica, and hard enough to scratch glass, would naturally be selected by them to assist in the grinding or trituration of their food, rather than the much softer black sand.

There was observed at one place an agglomeration of small, round grains, quite smooth outside, like very small fish eggs, which they perhaps were, or spores of some small toadstool or other fungus. They were transparent, and not much over one-quarter the size of the grains of sand mentioned above.

A great quantity of some dark-colored substance, finely comminuted and apparently of animal origin, was found, perhaps the remains of worms or meat of some kind; but, although most carefully sought for, there were no feet, wings, scales of lepidoptera, parts of insects, crustaceans, or muscular fibers of any sort among it, such as would have been likely to have survived the digestive process and given a clew to its character.

As we may see from the smallness and degree of convexity of their eyes that fish must be capable of seeing things infinitely smaller than would be visible to the human eye, this matter was perhaps composed of minute particles of both animal and vegetable origin which the fish met with and swallowed as it swam about, and which were perhaps too small to preserve any definite recognizable character, especially after passing through the stomach.

Their principal food, though, to judge from the great numbers of frustules of different kinds found in the stomach and intestines, were diatoms, the outer shells of which, being composed of almost pure silica, are well-nigh indestructible by the digestive process, fire, or the strongest acids.

After preparing the diatoms for examination under the microscope, it was seen that the greater part of these small organisms in view were *Naviculae* of small size, of the type known as *radiosa*, *arenaria*, etc., of two or three sizes, or of the *lanceolata* form, with divergent striae, such as are figured in Schmidt's Atlas of the Diatomaceae (plate 47) or varieties of that type. (See fig. 26, pl. III.) Some were much larger and some smaller than the figure, but mostly of the same general type.

Gomphonema was, as usual in Kansas gatherings, very rare, though four or five species were met with. *Cymbella*, also one of the commonest forms anywhere East, was equally scarce; and I had about concluded that none except small forms were present, when I unexpectedly came across an *Amphiprora* of the largest size (fig. 9, pl. II), and of a decidedly rare variety, not found in the forty-four Cincinnati slides. The individuals of this family are among the largest diatoms; and they were remarkably abundant, as if there was a savor or a large body of nourishment in them which had especially appealed to the fish's taste. Figure 10, plate II, is another individual in a different position.

A noticeable thing was not only the abundance of this large and rare *Amphiprora* not found at Gage's pond or Silver Lake, but the remarkably large number of fine *Pleurosigmae*, mostly *spencerii* or varieties, every field containing at least one and often several. The figure I give of it (No. 18, pl. III) would have been better if drawn on a larger scale; but I did not have room on the plate for one larger.

An unusually large form of *Amphora lineata*, not found at Gage's pond,

Silver Lake, or in the forty-four slides of Cincinnati diatoms, was quite abundant. Only one *Navicula* of the *rhomboides* type was seen, and that was a variety, the *Colletonema vulgare* of Thwaites. *Stauroneis phænicenteron*, one of the few distinctively fresh-water forms said to be found everywhere, was not met with.

Epithemia gibba, so remarkably abundant at Topeka, was present, but rather uncommon. Of the three or four species of *Nitzschiae*, only one seemed to be of common variety, and one of them, *Nitzschia sigma*, is catalogued by different authorities as a marine form. A most remarkable thing was that not a single *Surirella* of any kind was seen in the three slides mounted. As they are one of the most abundant forms everywhere, and there being plenty near at Medora, we must either conclude that there were none where the fish lived, or that they possessed some poisonous or other undesirable qualities which caused him to reject them.

One of the most remarkable things found was the *Mastagloia* (fig. 20, pl. III). The genus is almost exclusively marine or brackish, and only one of the two species are ever found in fresh water, and they are excessively rare. This one, *M. lacustris*, was not found at Cincinnati; though an allied species, *M. lanceolata*, was recognized there with some slight reserve. It is also catalogued by Thomas and Chase, but none of either was found at Gage's pond or Silver Lake.

Fig. 7, pl. II, seems to be what Grünow calls *Nitzschia apiculata*, though the blank line down the center and the absence of alea seem to identify with *Synedra*.

To give an idea of the relative proportions of the genera present in a field of view one-fiftieth of an inch in diameter, selected merely because it had an *Amphiprora* in it, so as to include that, there were the one *Amphiprora*, one *Amphora*, one *Cymbella*, two *Nitzschiae*, three *Pleurosigmae*, and thirty-four *Naviculae*.

The genera and species, so far as observed, were as follows:

<i>Amphiprora conspicua</i> (?), (perhaps <i>columetica</i> ?).	<i>Cymbella stomatophora</i> .
<i>Amphiprora paludosa</i> W. S., said to be British (fig. 9, pl. II).	<i>Cymbella tumidula</i> .
<i>Amphora cymbifera</i> Greg.	<i>Cymbella turgidula</i> .
<i>Amphora lineata</i> (fig. 15, pl. III).	<i>Cymbella</i> (two small unknown).
<i>Amphora</i> (No. 18, Schmidt's Atlas, pl. 39).	<i>Denticula splendens</i> .
<i>Coccineis pediculus</i> .	<i>Encyonema lunula</i> .
<i>Cocconema australicum</i> A. S.	<i>Epithemia gibba</i> .
<i>Cocconema cistula</i> .	<i>Epithemia gibba</i> , var. <i>ventricosum</i> .
<i>Cocconema helveticum</i> .	<i>Epithemia gibberula</i> .
<i>Cocconema hungaricum</i> .	<i>Epithemia</i> (like <i>musculus</i> , but ends not so sharp).
<i>Cocconema lanceolatum</i> .	<i>Epithemia</i> (uncertain, fig. 21, pl. III).
<i>Cocconema mexicanum</i> .	<i>Epithemia zebra</i> .
<i>Cyclotella rotula</i> .	<i>Gomphonema abbreviatum</i> .
<i>Cyclotella</i> (a small unknown).	<i>Gomphonema angustatum</i> , var. <i>intermedia</i> .
<i>Cymbella affinis</i> .	<i>Gomphonema capitatum</i> .
<i>Cymbella gastrooides</i> .	<i>Gomphonema clavatum</i> .
<i>Cymbella helvetica</i> .	<i>Gomphonema commutatum</i> .
<i>Cymbella kamchatica</i> Grün.	<i>Gomphonema commutatum</i> , var. <i>subramosum</i> .
<i>Cymbella minuscula</i> Grün.	<i>Gomphonema intricatum</i> , var. <i>pumila</i> .
<i>Cymbella</i> (No. 40 of Sch. 9, not named).	<i>Gomphonema olivaceum</i> .

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|---|---|
| Gomphonema olivaceum, var. vulgaris. | Navicula radiososa Kg. |
| Gomphonema ventricosum. | Navicula radiososa, var. acuta. |
| Homœocladia sigmaoidea. | Navicula rhomboides, var. (Colle- |
| Mastagloia smithii Thw., var. lacus- | tonema vulgare Thw.) |
| tris, Grün. (fig. 20, pl. III). | Navicula rupestris (Pinn.) Grün. |
| Navicula amphiceros? (fig. 6, pl. II). | Navicula smithii (?). |
| Navicula bacillum. | Navicula subcapitata, var. stauronei- |
| Navicula borealis (var. small, with nine | formis (fig. 22, pl. III). |
| coarse striae). | Navicula subinflata (fig. 25, pl. III). |
| Navicula brebissonii. | Navicula stauroptera. |
| Navicula cymbula Donk. | Navicula stauroptera parva Grün. |
| Navicula elliptica. | Navicula tabellaria. |
| Navicula elliptica, var. oblongella (like | Navicula tenella. |
| fig. 24, pl. III). | Navicula (unknown, perhaps naveana?). |
| Navicula gracilis (Kg.) Grün. | Nitzschia amphioxys. |
| Navicula gregaria Donk. | Nitzschia amphioxys, var. vivax (fig. |
| Navicula interrupta (Pinn.) S. W. | 2, pl. II). |
| Navicula lanceolata (Kg.), var. | Nitzschia angustata. |
| Navicula leptogongyla. | Nitzschia frustulum. |
| Navicula longa. | Nitzschia heufleriana. |
| Navicula macra. | Nitzschia hungaricum. |
| Navicula mutica, var. goeppertiana. | Nitzschia sigma. |
| Navicula (large, coarsely marked, | Nitzschia stagnarum Rabh. |
| lanceolate, unknown). | Nitzschia triblionella. |
| Navicula (No. 11 of Schmidt's 47, not | Pleurosigma gracilentum Rabh. |
| named). | Pleurosigma spencerii (fig. 18, pl. III). |
| Navicula (No. 13 of same, not named). | Pleurosigma sciotense. |
| Navicula (No. 15 of same, not named). | Pleurosigma kutzinghii. |
| Navicula (No. 22 of Schmidt's 44, not | Synedra acus. |
| named). | Synedra crotonensis. |
| Navicula (No. 23 of Schmidt's 44, but | Synedra danica. |
| rather coarser). | Synedra familiaris. |
| Navicula (No. 32 of Schmidt's 44, with | Synedra (an end of, perhaps, Chaseii ?). |
| some reserve). | Synedra pulchella, forma major. |
| Navicula obtusata. | Synedra ulna. |
| Navicula pumila Grün. | Total genera, 16; species, 100. |